**Roll No. .....**

| Question Booklet Number |
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**O. M. R. Serial No.**

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# M. Sc. (Biotechnology) (Fourth Semester)
# (NEP) EXAMINATION, 2025-26

## NANOTECHNOLOGY

| Paper Code | | | | | | | |
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| Questions Booklet Series |
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*Time : 1:30 Hours* ] [ *Maximum Marks : 75*

**Instructions to the Examinee :**

1. Do not open the booklet unless you are asked to do so.

2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.

3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

**परीक्षार्थियों के लिए निर्देश :**

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।

2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।

3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

**(Remaining instructions on the last page)** **(शेष निर्देश अन्तिम पृष्ठ पर)**

*(Only for Rough Work)*

1. What is the typical size range of nanoparticles used in drug delivery ?
   (A) 1–100 nm
   (B) 1–10 μm
   (C) 100–1000 μm
   (D) >1 mm

2. Which nanocarrier is best suited for gene delivery ?
   (A) Liposomes
   (B) Metallic nanoparticles
   (C) Carbon nanotubes
   (D) Dendrimers

3. The Enhanced Permeability and Retention (EPR) effect is associated with :
   (A) Brain targeting
   (B) Lung targeting
   (C) Tumor targeting
   (D) Skin delivery

4. Which targeting mechanism involves ligand-receptor interaction ?
   (A) Passive targeting
   (B) Active targeting
   (C) Random diffusion
   (D) Osmosis

5. Solid lipid nanoparticles are mainly used for :
   (A) Gas delivery
   (B) Hydrophilic drug delivery only
   (C) Lipophilic drug delivery
   (D) DNA sequencing

6. What property of nanoparticles enhances cellular uptake ?
   (A) Large size
   (B) Neutral charge
   (C) Small size
   (D) High density

7. Which route of administration is most commonly associated with nanoparticle drug delivery ?
   (A) Intravenous
   (B) Oral only
   (C) Intramuscular only
   (D) Topical only

8. Dendrimers are best described as :
   (A) Linear polymers
   (B) Branched, tree-like macromolecules
   (C) Metallic nanoparticles
   (D) Vesicular systems

9. What is the main advantage of nanostructures in drug delivery ?
   (A) Increased toxicity
   (B) Targeted delivery
   (C) Reduced solubility
   (D) Rapid degradation

10. Which nanostructure is primarily composed of lipid bilayers ?
   (A) Liposome
   (B) Dendrimer
   (C) Polymeric nanoparticle
   (D) Solid lipid nanoparticle

11. In biosensing applications, quantum dots are primarily used for :

(A) Magnetic control

(B) Fluorescent signal generation and amplification

(C) Catalysis

(D) Data storage

12. Which nanomaterial is widely used in biosensors due to its excellent conductivity and surface area ?

(A) Graphene

(B) Titanium dioxide

(C) Zinc oxide

(D) Silica

13. The main role of nanodevices in biosensors is to :

(A) Increase sensor size

(B) Eliminate electronic components

(C) Store biological information

(D) Enhance detection sensitivity and specificity

14. Light-responsive nanoparticles are primarily applied in :

(A) MRI imaging

(B) Photothermal therapy and bioimaging

(C) Blood pressure regulation

(D) pH stabilization

15. Which of the following is NOT commonly used as a stimulus for responsive nanoparticles ?

(A) Acoustic noise

(B) Light

(C) Enzymatic activity

(D) Redox conditions

16. Which of the following can act as a trigger for smart nanoparticles ?

(A) Magnetic field

(B) pH variation

(C) Temperature change

(D) All of the above

17. Smart stimuli-responsive nanoparticles are those that :

(A) Degrade immediately after use

(B) Remain inactive under all conditions

(C) Respond to specific environmental or external triggers

(D) Are composed only of metals

18. A multilayer thin film is defined as :

(A) A single uniform coating

(B) A stack of alternating thin layers of different materials

(C) A film with random defects

(D) A discontinuous coating

19. In semiconductor devices, thin films are mainly used to :

(A) Improve flexibility

(B) Store electrical energy

(C) Form insulating or conducting layers in circuits

(D) Protect against dust

20. Which technique is primarily used to measure thin film thickness ?

(A) UV-Visible spectroscopy

(B) X-ray diffraction

(C) Fourier-transform infrared spectroscopy

(D) Ellipsometry

21. Which method is widely used for thin film deposition ?

(A) Physical Vapor Deposition (PVD)

(B) Scanning electron microscopy

(C) Freeze drying

(D) Polymer molding

22. Atomic Layer Deposition (ALD) is preferred because it provides :

(A) Rapid but uncontrolled coating

(B) Low-cost bulk deposition

(C) Large-scale material production

(D) Atomic-level control over film thickness and uniformity

23. Which property of thin films is crucial for solar cell performance ?

(A) Optical transparency combined with electrical conductivity

(B) Magnetic behavior

(C) Thermal expansion coefficient

(D) Surface color

24. In nanotechnology, a thin film refers to :

(A) A flexible plastic sheet

(B) A material layer with thickness in nanometer to micrometer range

(C) A thick insulating coating

(D) A fiber-optic component

25. In nanopore DNA sequencing, nucleotide identification is primarily based on :

(A) Electrical current variations during translocation

(B) Net charge of nucleotides

(C) Length of DNA fragments

(D) Fluorescence emission

26. How do nanopores function in molecular sensing ?

(A) By emitting radiation signals

(B) By trapping molecules using magnetic forces

(C) By detecting changes in ionic current as molecules pass through

(D) By producing color changes

27. What is a nanopore ?

(A) A nanoscale robotic tunnel

(B) A tiny pore used for molecular detection and analysis

(C) A heat-generating nanoparticle

(D) A conductive nanowire

28. A nanocapsule is best defined as :

(A) A metallic nanoparticle used in imaging

(B) A nanoscale hollow structure that encapsulates active substances

(C) A viral vector used in vaccines

(D) A tubular carbon nanostructure

29. The primary biomedical application of nanocapsules is :

(A) Water purification

(B) Mechanical reinforcement

(C) Targeted delivery of therapeutic agents

(D) Conductive material fabrication

30. Which technique is most commonly used to determine the size distribution of nanocapsules in suspension ?

(A) UV-Visible spectroscopy

(B) X-ray diffraction (XRD)

(C) Dynamic Light Scattering (DLS)

(D) Thermogravimetric Analysis (TGA)

31. Zeta potential is primarily used to determine :

(A) Shape of nanocapsules

(B) Surface charge and colloidal stability

(C) Optical properties

(D) Internal temperature

32. Which technique is most appropriate for analyzing surface morphology of nanocapsules ?

(A) Nuclear Magnetic Resonance (NMR)

(B) Atomic Absorption Spectroscopy (AAS)

(C) Scanning Electron Microscopy (SEM)

(D) ELISA

33. A key advantage of nanocapsules in drug delivery is :

(A) Increased manufacturing cost

(B) Non-specific drug distribution

(C) Controlled and sustained drug release

(D) Complete resistance to degradation

34. Biomimicry in nanotechnology refers to :

(A) Direct extraction of materials from organisms

(B) Genetic modification using plant DNA

(C) Imitating biological systems to develop functional nanomaterials

(D) Using DNA for digital data storage

35. Spider silk is often mimicked in nanomaterial design because of its :

(A) Optical reflectivity

(B) Adhesive nature

(C) High strength and elasticity

(D) Magnetic properties

36. Which of the following is a bioinspired nanocarrier commonly used in drug delivery ?

(A) Liposomes

(B) Fullerenes

(C) Graphene oxide

(D) Carbon nanotubes

37. The iridescent coloration of butterfly wings arises due to :

(A) Structural nanoscales that reflect and interfere with light

(B) Chemiluminescence reactions

(C) Fluorescent pigments

(D) Bioluminescent microorganisms

38. Which natural surface has inspired the design of superhydrophobic materials ?

(A) Gecko feet

(B) Lotus leaf

(C) Butterfly wing

(D) Spider silk

39. Bioinspired nanostructures are best described as :

(A) Nanostructures naturally produced by living organisms only

(B) Mineral-based nanostructures used in industry

(C) Fossil-derived nanoscale materials

(D) Synthetic nanostructures designed by mimicking biological systems

40. Which cytoskeletal component (~25 nm diameter) is primarily responsible for intracellular transport ?

(A) Microfilaments

(B) Intermediate filaments

(C) Dynein-associated filaments

(D) Microtubules

41. A nanoscale pore in an insulating membrane used for single-molecule detection is called :

(A) Nanocrystal

(B) Nanotube

(C) Micropore

(D) Nanopore

42. Matrix-type nanostructures are typically associated with :

(A) Nanospheres

(B) Nanoparticles

(C) Nanopores

(D) Nanotubes

43. $C_{60}$ is commonly known as :

(A) Fullerene

(B) Quantum dot

(C) Dendrimer

(D) Graphene

44. Which of the following is an example of an organic nanomaterial ?

(A) Liposomes

(B) Quantum dots

(C) Hydrogels

(D) Iron oxide nanoparticles

45. Which of the following is NOT an inorganic nanomaterial ?

(A) Dendrimer

(B) Carbon nanotube

(C) Mesoporous silica

(D) Gold nanoshell

46. The term 'nanotechnology' was first introduced by :

(A) Richard Feynman

(B) Norio Taniguchi

(C) Eric Drexler

(D) Karl Peter

47. TEM stands for :

(A) Transmission Electrical Microscope

(B) Transmitted Electron Microscope

(C) Transmission Electron Microscope

(D) Transmitting Electro Microscope

48. Nanopowders are generally defined as powders having particle sizes less than :

(A) 100 nm

(B) 1,000 nm

(C) 10,000 nm

(D) 1,00,000 nm

49. Which statement correctly describes nanomaterial fabrication approaches ?

(A) Only top-down approaches are used

(B) Only bottom-up approaches are used

(C) Both top-down and bottom-up approaches are used

(D) Neither approach is relevant to nanotechnology

50. Quantum dots are best classified as :

(A) Inorganic semiconductor nanomaterials

(B) Organic polymeric nanomaterials

(C) Biological nanostructures

(D) Metallic bulk materials

51. The main purpose of surface modification in imaging nanoparticles is to :

(A) Increase particle size

(B) Reduce stability

(C) Enhance targeting and biocompatibility

(D) Change colour only

52. Which nanomaterial is commonly used in biosensing and diagnostic assays ?

(A) Dendrimers

(B) Nanocapsules

(C) Carbon nanotubes

(D) Micelles

53. Nanoparticles functionalized with antibodies are used for :

(A) Random distribution

(B) Non-specific binding

(C) Targeted imaging

(D) Structural reinforcement

54. Which property allows nanoparticles to accumulate in tumor tissues for imaging ?

(A) High density

(B) EPR (Enhanced Permeability and Retention) effect

(C) Low solubility

(D) High crystallinity

55. What is the key advantage of nanoparticle-based contrast agents ?

(A) Reduced sensitivity

(B) Enhanced signal intensity

(C) Increased side effects

(D) Limited targeting ability

56. Which imaging technique commonly uses fluorescent nanoparticles ?

(A) X-ray imaging

(B) MRI

(C) Optical imaging

(D) Ultrasound

57. Gold nanoparticles are commonly used in diagnostics due to their :

(A) Optical properties

(B) Electrical insulation

(C) High toxicity

(D) Low surface area

58. Quantum dots are especially useful in imaging because of their :

(A) High density

(B) Magnetic properties

(C) Size-dependent fluorescence

(D) Large size

59. Which type of nanoparticle is widely used in MRI imaging ?

(A) Gold nanoparticles

(B) Liposomes

(C) Iron oxide nanoparticles

(D) Polymeric nanoparticles

60. Nanoparticles used in imaging primarily function as :

(A) Drug carriers

(B) Contrast agents

(C) Catalysts

(D) Structural materials

61. Surface functionalization of nanostructures is mainly done to :

(A) Increase particle weight

(B) Improve targeting and interaction with biological molecules

(C) Reduce particle size

(D) Change colour

62. Which characteristic ensures minimal toxicity of nanostructures ?

(A) Chemical inertness and biocompatibility

(B) High reactivity

(C) Large particle size

(D) High crystallinity

63. Why is biodegradability important for nanostructures in biological systems ?

(A) To increase persistence in the body

(B) To prevent breakdown

(C) To allow safe elimination from the body

(D) To enhance metallic properties

64. Which factor influences the cellular uptake of nanostructures ?

(A) Color

(B) Particle size and shape

(C) Odor

(D) Thermal conductivity

65. What is the primary requirement for nanostructures used in drug delivery systems ?

(A) High toxicity

(B) Rapid aggregation

(C) Poor solubility

(D) Controlled release capability

66. Which surface property helps nanostructures evade the immune system ?

(A) High surface roughness

(B) Positive charge only

(C) PEGylation (surface modification with polyethylene glycol)

(D) Hydrophobic coating

67. What size range is generally considered optimal for nanostructures used in biological applications ?

(A) 1–10 μm

(B) 10–200 nm

(C) 1–5 mm

(D) > 10 μm

68. Which property is most critical for ensuring compatibility of nanostructures with biological systems ?

(A) Biocompatibility

(B) High density

(C) Electrical conductivity

(D) Magnetic properties

69. Which method is commonly used for the preparation of liposomal nanovesicles ?

(A) Electrospinning

(B) Thin-film hydration

(C) Centrifugation

(D) Chromatography

70. What type of drugs can be encapsulated in nanovesicles ?

(A) Only hydrophilic drugs

(B) Only hydrophobic drugs

(C) Both (A) and (B)

(D) Only gaseous drugs

71. Which of the following is a key advantage of exosomes as nanovesicles ?

(A) Synthetic origin

(B) High immunogenicity

(C) Poor biocompatibility

(D) Natural cell-derived targeting ability

72. Nanovesicles are widely used in drug delivery because they :

(A) Prevent drug absorption

(B) Cause rapid drug degradation

(C) Enhance bioavailability and targeting

(D) Increase toxicity

73. Which nanovesicle system is formed using non-ionic surfactants ?

(A) Liposomes

(B) Exosomes

(C) Polymeric vesicles

(D) Niosomes

74. The primary structural component of liposomal nanovesicles is :

(A) Proteins

(B) Lipid bilayer

(C) Metal ions

(D) Polysaccharides

75. Which type of nanovesicle is naturally derived from cells ?

(A) Liposomes

(B) Niosomes

(C) Exosomes

(D) Polymeric vesicles

76. Nanovesicles are best defined as :

(A) Solid nanoparticles without internal compartments

(B) Hollow, spherical structures composed of lipid bilayers

(C) Metallic nanostructures

(D) Crystalline bulk particles

77. Nanocapsules are particularly useful for delivering :

(A) Hydrophobic drugs
(B) Only gaseous drugs
(C) Only inorganic ions
(D) Only large crystals

78. What is a key advantage of nanocapsules in drug delivery ?

(A) Increased drug degradation
(B) Non-specific targeting
(C) Immediate drug release
(D) Controlled and sustained release

79. Which material is commonly used for preparing polymeric nanocapsules ?

(A) Gold
(B) Silica
(C) PLGA
(D) Iron oxide

80. In nanocapsules, the drug is typically :

(A) Adsorbed on the surface
(B) Encapsulated within the core
(C) Chemically bonded to the shell only
(D) Dissolved in the external medium

81. Nanocapsules are best described as :

(A) Vesicular systems with a core-shell structure
(B) Solid particles without any internal cavity
(C) Metallic nanostructures
(D) Crystalline bulk materials

82. Consider the following statements about nanosensors :

(I) Nanosensors are devices that utilize nanotechnology to detect and quantify physical, chemical, or biological signals in real time.
(II) They have applications in diverse fields such as healthcare, environmental monitoring, food safety, and agriculture.
(III) They can be used to monitor the quality of agricultural products during storage and transportation.

Which of the statements given above is/are correct ?

(A) I only
(B) II and III only
(C) I and III only
(D) I, II and III

83. Materials at the nanoscale exhibit unique physical and chemical properties compared to their bulk counterparts. This is primarily because :

(A) They possess a higher surface area-to-volume ratio
(B) Quantum effects become significant
(C) Both (A) and (B)
(D) None of the above

84. Fullerenes were discovered in 1985 by Harry Kroto, Richard Smalley, and Robert Curl, who were later awarded the 1996 Nobel Prize in :

(A) Physics
(B) Chemistry
(C) Medicine
(D) Engineering

85. Consider the following statements regarding nanotechnology applications :

(I) The incorporation of specifically engineered nanoparticles can enhance the fragrance intensity of perfumes.
(II) Advanced nanoencapsulation methods can improve food properties, including the sensory perception of taste during consumption.

Which of the statements given above is/are correct ?

(A) I only
(B) II only
(C) Both I and II
(D) Neither I nor II

86. Which factor can lead to aggregation of colloidal nanoparticles ?

(A) Reduction in electrostatic repulsion
(B) Increase in temperature
(C) Decrease in particle concentration
(D) Increase in solvent viscosity

87. Which technique is commonly used to measure particle size in colloidal systems ?

(A) UV-Vis spectroscopy
(B) X-ray diffraction
(C) Chromatography
(D) Dynamic Light Scattering (DLS)

88. The Brownian motion in colloidal nanostructures is caused by :

(A) Gravity
(B) Magnetic forces
(C) Random collisions with solvent molecules
(D) Chemical reactions

89. Which property is most important for the stability of colloidal nanostructures ?

(A) Colour
(B) Surface charge
(C) Shape
(D) Density

90. Colloidal nanostructures are best defined as :

(A) Particles dispersed in a continuous medium with size in nanometer range
(B) Bulk materials with no dispersion
(C) Only metallic solids
(D) Macroscopic suspensions

91. What is a key advantage of nanostructured drug delivery systems ?

(A) Non-specific distribution
(B) Improved bioavailability
(C) Increased dosage requirement
(D) Rapid clearance

92. Which characterization technique measures particle size distribution ?

(A) XRD
(B) UV-Vis spectroscopy
(C) SEM
(D) Dynamic Light Scattering (DLS)

93. What is the main function of targeting ligands in nanocarriers ?

(A) Increase drug degradation
(B) Enhance solubility
(C) Bind to specific cells
(D) Reduce drug loading

94. Which nanostructure is best for hydrophobic drug encapsulation ?

(A) Micelles
(B) Liposomes
(C) Dendrimers
(D) Nanotubes

95. Which technique is used for surface modification of nanoparticles ?

(A) Lyophilization
(B) Centrifugation
(C) Conjugation with ligands
(D) Filtration

96. PEGylation of nanoparticles helps in :

(A) Increasing toxicity
(B) Reducing circulation time
(C) Enhancing immune recognition
(D) Increasing circulation time

97. Nanocapsules differ from nanospheres because they :

(A) Have a matrix structure
(B) Have a core-shell structure
(C) Are metallic
(D) Are larger in size

98. Which material is commonly used in polymeric nanoparticles ?

(A) Gold
(B) PLGA
(C) Silica
(D) Iron oxide

99. What is the major limitation of nanoparticle drug delivery systems ?

(A) Poor stability
(B) High specificity
(C) Controlled release
(D) Enhanced bioavailability

100. Which nanostructure has a hydrophilic core and hydrophobic shell ?

(A) Liposome
(B) Micelle
(C) Dendrimer
(D) Nanocapsule

*(Only for Rough Work)*

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

**Example :**

**Question :**

Q. 1 (A) ● (C) (D)
Q. 2 (A) (B) ● (D)
Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

**Impt. :** On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

**उदाहरण :**

**प्रश्न :**

प्रश्न 1 (A) ● (C) (D)
प्रश्न 2 (A) (B) ● (D)
प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

**महत्वपूर्ण :** प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।